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The American Association for the Advancement of Science:
Some Thoughts on the Problem of Progress and Decline: DR. JOHN R. SWANTON 253
Obituary:
Edmund Beecher Wilson: PROFESSOR THOMAS HUNT MORGAN. *Samuel Steen Maxwell:* PROFESSOR J. M. D. OLMSTED. *Recent Deaths* 258
Scientific Events:
The Imperial Bureau of Dairy Science; Scholarships of the Westinghouse Electric and Manufacturing Company at the Carnegie Institute of Technology; Grants of the Commonwealth Fund in Aid of Medical Research; Grants of the Geological Society of America; The Pacific Division of the American Association for the Advancement of Science 260
Scientific Notes and News 263
Discussion:
Nuclear and Cytoplasmic Effects of Ultra-Violet Light: PROFESSOR A. C. GIESE. *A Species of Azotobacter Tolerant to High Acidity:* DR. ROBERT L. STARKEY. *Hippoboscid Flies from North American Doves:* DR. J. BEQUAERT. *Stomatal Index and Transpiration Rate of Leaves:* PROFESSOR HUGH B. SMITH 266
Societies and Meetings:
The New York Meeting of the American Physical Society: DR. CARYL P. HASKINS 269
Special Articles:
Pathogenic Pleuropneumonia-like Microorganisms from Acute Rheumatic Exudates and Tissues: DR. HOMER F. SWIFT and DR. THOMAS MCPHERSON BROWN. *The Process of Continuous Deamination and Reamination of Amino Acids in the Proteins of Normal Animals:* DR. RUDOLF SCHOENHEIMER, DR. S. RATNER and D. RITTENBERG. *A Method for Producing Persistent Hypertension by Cellophane:* DR. IRVINE H. PAGE. *The Successful Treatment of Meningoencephalitis, Associated with Canine Distemper, with Sulfanilamide:* DR. M. L. MORRIS and DR. T. J. MURRAY 271
Science News 6

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SOME THOUGHTS ON THE PROBLEM OF PROGRESS AND DECLINE[1]

By Dr. JOHN R. SWANTON
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THE privilege of delivering this address comes to me in the midst of intensive work in fields somewhat removed from the ordinary domain of anthropology, and that is why I have to offer you merely "some thoughts" on a great subject instead of the carefully formulated presentation which it should properly demand. Much of what I have to say will fall in the realm of general theory rather than that of science proper, and this must be my excuse for seeming to intrude into the territories of other disciplines. It would be more than presumptuous in me to do this if the question at issue concerned matters of fact, but it is otherwise when deductions are made from facts which transcend the boundaries of science as ordinarily conceived, and may become bases for attitudes in the world at large affecting the lives of thousands of human beings.

First, I wish to say a word about that naive materialism which was more in vogue perhaps before the birth of the new physics than it is to-day. There is still a popular illusion that because science teaches that a physico-chemical world was necessary before organisms could exist upon it, and because paleontology has demonstrated that organisms have appeared successively in more and more complicated forms, therefore the organic came *in toto* out of the inorganic, and each succeeding level of organic life *in toto* out of the preceding one. Now, the observations of succession and relation are scientific; the deductions as to origin are philosophic. Yet superficial thinkers shift from one

[1] Address of the Vice-president and Chairman for Anthropology, American Association for the Advancement of Science, Richmond, December 29, 1938.

to the other without appearing to realize that they have made a fundamental change and an unprovable deduction. Although widely attributed to science and made the basis for that trite remark, "the materialism of science," this deduction never has been a part of science. Nevertheless, astronomers who insist on treating organic life as a rare phenomenon contribute to the error because life is made to appear as an abnormal intruder into the universe, when, in fact, the argument is entirely inferential, based on the assumption that life can exist under no other conditions than those which limit it on a single planet. Of course the anthropologist may have the last word, while granting all that the inorganicist demands, because he may claim the inorganicist himself. The latter may look out into a cosmos seemingly devoid of life phenomena, but the anthropologist can remind him that the observer himself is it, and that he views the heavens through instruments created by such organisms, that his sensory organs and nervous system belong to one, and that what he sees and the deductions he draws are all conditioned by the past history of his race and of his science, by his training and by his personal beliefs and prejudices.

> When me they fly, I am the wings;
> I am the doubter and the doubt.

The anthropologist may, therefore, obtain some final compensation for being regarded as a somewhat crude interloper into the well-beformulated preserves of the "exact" sciences. In the last act he can claim them all. I am indulging in this philosophic prelude, however, without any such grandiose object in view but merely as a kind of anthropological declaration of independence.

If I seem to detect a philosophical slip on the part of inorganicists in insisting upon the priority of the objects of their study, I believe I detect another in their treatment of cosmic history. As far back as I can remember, and with almost complete unanimity, they have saddened my mind and disturbed my digestion with the spectacle of a running-down universe. To be sure, the general foreclosure is placed at a rather comfortable distance ahead and the new physics has granted very extensive reprieves, even if not a wholly new deal, but apparently not all inorganicists are willing to put the skeleton entirely back into the closet. They will suggest, like Eddington, that there is a monster on our trail known as the second law of thermodynamics which there is no way of shaking off, and that the universe with us poor mortals on its back is running down a blind alley where the monster will certainly corner us and dispose of us at last by a general freeze, unless some star comes along beforehand and gives us the merciful alternative of death by cremation.

But however scientifically justified the "heat-death" concept may be, it is philosophically unsound as a *total* explanation. This is no cavalier assertion of mine. It was demonstrated by Professor Josiah Royce, of Harvard, for instance, long ago, though the special form of the theory in his time was somewhat different from that current to-day. Any one wishing to examine his argument at length will find it in Chapter X of his "Spirit of Modern Philosophy." But, in brief, we can not imagine ourselves to be existing in a fragment of finite time balanced between an infinite period of running-down and an infinite period of stagnation consequent upon the diffusion of energy. If the period of approach were infinite, it would have no end. If the period of stagnation were infinite, how could it have a beginning? We must either suppose we are looking out upon a one-way street and somewhere there is another one-way street carrying celestial traffic in the other direction or such phenomena are tidal and the present ebb will be followed by a flow.

At first sight the biologists seem to be more encouraging than the inorganicists, for organic evolution suggests progress and even as dour a member of the guild as Hooton talks hopefully of it as a movement "up from the ape"—parasitic forms of course excepted. But the eugenists, and Professor Hooton along with them, soon shatter our self-complacency again and plunge us back into the slough of despond, for it seems that the biological advance which our animal and early human ancestors attained is being thrown to the dogs —or even farther—by the perverse refusal of scientists and members of other superior classes—if there are any others—to reproduce their kind. The only point on which they leave us in the dark is as to how many of them are to perform this genetic miracle on the prevailing incomes.

But here again I seem to find flaws in the argument. We are led to believe that there is danger that we shall be overwhelmed with morons on account of the selfishness of the better classes and the recklessness of the worser ones in the matter of reproduction, and because natural selection and the survival of the fittest have been interfered with. But by the same token we must assume that natural selection has done its full duty by our animal relatives, the anthropoids. Yet, after half a million years or so the biologically virtuous anthropoids are on the verge of extinction, while mankind, though he has tampered with his environment in the most shameless manner, has managed to spread over almost all the globe. In the face of this fact, however, we are told that human generation like the universe at large is on the down grade and there is no salvation except in sterilization and in selective birth-promotion, genetic devolution being irreversible. We seem, indeed, to have here a kind of biological Calvinism, a new doctrine of total depravity.

But does it not seem incredible that the relatively

small number of our first human ancestors—highly selected, it is presumed, up to the fatal moment of becoming human—could have brought with them across from the animal world such multitudes of germinal defects? And if they did not, certain defects must have been acquired since that time, they are, *ipso facto,* not original or immutable, and there seems to be no good reason to suppose they are beyond treatment. While conceding that some genetic strains may be so far gone in depravity that they had best be eliminated, I can not therefore deny myself the hope that defects of others are curable. There is no surer way to fail than to postulate failure. "It can't be done" in the mouths of people is often the only reason why it hasn't been done.

There is a great deal to be said for eugenic theory, as I think all anthropologists will admit, but it has been made the starting point for all sorts of fantastic attempts at race betterment and genetic determination as far removed from scientific sanity as can well be imagined. In particular, there is a variety of eugenism abroad which not only believes in regulating human generation but believes it possesses the wisdom to do so above all scientists and that virtue consists in the production of human beings of a particular racial type, Nordic or Mediterranean or some other of supposed superior quality.

As has been repeatedly pointed out, there is no historical or biological justification for such a dogma, and hybridization, when not too wide or involving a psychological shock, seems to have proved of more advantage to mankind than the production of purer strains, while those peoples who gave birth to the higher cultures were very diverse. If we contemplate the six or seven centers from which civilization appears to have sprung, we find that the Egyptians, Cretans and probably the people of the Indus valley were dolichocephalic as well as the Semitic element in the Tigris-Euphrates valley, but that the Hurrians, Sumerians, Chinese and Maya were prevailingly brachycephalic, both types occurring in Peru. It is significant furthermore that all these pioneers in the civilizing process belonged to the swarthy races. If Negroes are not represented among them, neither are Nordics, and both are probably absent for the same reason, because they are side-branches of the human family and removed farther from the primary cultural centers. Or are the extreme blacks and the extreme whites both inferior to the rest?

Language is, of course, a cultural feature, but it is one of the more persistent features and is often popularly confounded with race in discussions of racial differences, superiorities and inferiorities. Now, in the culture centers just enumerated, aside from the language of the Cretans, the exact nature of which is unknown, the languages spoken—Egyptian, Semitic, Dravidian, Chinese, Maya, Quechua and Yunca—are, with the possible exception of the first two, totally unrelated and differ completely in structure. Thus both in physical type and in language the peoples who made the earliest cultural advances in both the Old and the New Worlds were diverse, and it may be added that peoples more closely related to each in both particulars remained on a lower level.

Since a dense population seems to be demanded by modern dictators as an adjunct to an aggressive policy, it may be noted that two centers, China and India, have such enormous populations without any aggressive policy to motivate them, and that the centers farther west which developed such a policy, notably those in the Tigris-Euphrates valley, lost. In the New World, Peru, which had a dense population for this continent, did develop an aggressive policy, but the Maya did not. On the other hand, we have numerous cases of aggressive empires, such as those of the Arabs, Romans, Huns and Mongols, which ultimately lost rather than gained.

The relation of civilization to various forms of government is especially pertinent. Offhand one would say that a stable government which gathers under itself all related people in a particular area would be more likely to advance in civilization and to advance civilization than a weak government and divided authority. This expectation is in some measure realized. The Victorian Age in England was one of great intellectual activity and productivity, and so were that of Louis XIV in France, the late sixteenth century in Spain and the Augustan Age in Rome. But, strikingly in contrast in every particular, are Greece of the fifth century B.C., Italy of the Renaissance, the Low Countries in the early seventeenth century and Germany in the age of Goethe and Schiller. Thus the highest spots in intellectual productivity until very recent times have been reached in countries divided into small competing states.

This is not to deny that governments are able to contribute to cultural advance but to point out their limitations. We are here brought face to face with the question of regimentation, to what extent and in what directions it is of value. For regimentation of some sort there is certain to be as long as men are brought together in societies and attempt collective activities. One type of regimentation which is now being very much discussed is, indeed, as old as human society. It is the kind of regimentation which lays upon each member of the group the duty of supplying food, clothing and shelter to all. Most primitive communities are mutual insurance companies and very effective ones. The food-gatherers of the group, using the term food-gatherers in its broadest sense, are not permitted to monopolize the products of their industry and drive bargains for their surplus with other members of the community. Distribution of food is

expected and enforced. This might be thought the occasion for an unhealthy crop of drones, and many do exist, but it is doubtful whether the proportion is any greater than in European society. Group opinion is everywhere the most powerful deterrent to dissenters, and members of the relatively small groups of which primitive societies consist are past masters of the art of making non-conformists miserable. The successful hunter will not raise his social status by cornering the food market and by "holding up" other members of the tribe in times of scarcity, but through the credit he receives as the savior of the town. Competition in the monopolization of values does not exist, but instead emulation in the performance of services. This does not mean that individuals in primitive societies are better or more unselfish than those in our own, merely that conditions have enforced upon them the desirability of mutual insurance for the basal needs. Our own society is often obliged to perform these same services, though usually in indirect ways, and we are not able to bring the same social pressure to bear effectively on all hoarders alike.

A regimentation like this which has for its object the care of the underprivileged is, thus, one of respectable antiquity and current utility. It needs no apology. The regimentation which we observe to-day under dictatorial governments, while performing this function incidentally, is of a very different type and motivated to different ends. The primitive societies of which I have been speaking are governed by a body of custom. They are governments by law instead of men, and while demanding the observance of certain taboos which to us often seem absurd, do not interfere beyond them in the private lives of their members. Within those limits the independence of the individual and the family is powerfully and stubbornly maintained. Moreover, and this is a matter to be particularly noted, their main concern is with the internal well-being of the community, not with its external policy.

The modern regimented state, on the other hand, is a government of men rather than laws, and, what is worse, it is a government in which foreign policy is a major interest and the military motive a primary concern. The dictator knows well that there are no motives as strong as fear and hate to induce masses of people to submit to regimentation, for such feelings support armies, and military life calls for just that kind of government. Therefore, a bogey is needed to hold constantly before the minds of the people, and this, though it may be furnished by a capitalist or communist class or party, or a religious group, is most successfully met by a foreign country. Frighten people sufficiently by telling them what outrages such a nation intends to perform upon them, and persuade them that their only hope is in absolute unity and "preparedness," and you have them in a mood to submit to all demands and ready to mob any one whom you designate as sympathetic with the "enemy." When people are thoroughly frightened or angry they lose their self-control and their willingness to exercise it. But of course the stimulus has to be supplied repeatedly in order to keep the desired emotions alive, discordant notes might destroy the effect, and so there must be no opposition press, no dissenting voices. The cult of fear and hatred must be blown up regularly. The least wavering must be labeled as the work of the chosen devil or group of devils. Everything contrary to the dictatorial superstitions is occasioned by "a fiendish conspiracy," and so on. Of course, the wise among the dictators must realize that these constant applications of the shudder complex can not go on indefinitely. The slogans which at first excited fear and wrath begin to grow stale. They are presently repeated mechanically, with the tongue farther and farther into the cheek, become objects first of covert and finally of open jest, and the end of the régime is in sight unless the prejudice-pump can be reprimed with a foreign war. War itself is not desired. Threat of war is useful because it keeps regimentation alive, but war might wreck the entire structure. It is, therefore, only a last resort.

In the meantime, however, the hysteria on which dictatorships thrive has done great damage to civilization. The recurrent image-breaking in which works of art and beautiful buildings have perished, although the fury which occasioned it has in many cases been due to real abuses and sometimes accompanied ethical reform, has made the world poorer none the less. These emotional upheavals have not, of course, always been associated with dictatorships, but dictatorships make willing use of them. The burning and proscription of books with which the party in power happens to disagree, and in which modern dictators are bedfellows with the Chinese emperor who built the Great Wall, with the Caliph Omar and with many religious sectarians, represents another loss. How great would have been our heritage—how much greater than it is—if the good things of one culture had been preserved by the next and only the abuses discarded, instead of having good and bad alike exposed to the destructive outbursts of fanatic frenzy which have periodically disgraced and debased mankind!

While much of this destruction has been wrought by mobs armed with nothing more than sticks and stones and hatred, the greatest losses have been due directly or indirectly to the maintenance of the institution we call war. I have already spoken of war, or rather the threat of war, as the chief weapon in the armory of a dictator. War does not settle, but instead postpones the settlement of, questions which must finally be solved by general consent and sometimes by the working of

natural laws. Violence we may always expect, but it is one thing to deal with violence breaking out against the law and quite another to create deliberately war machines which are symbols of violence and therefore weapons for the perpetration of irrational acts. I am not an advocate of passive resistance in the face of aggression, but that does not prevent me from regarding the entire war institution, as such, as a total loss to humanity. It is, I am aware, considered by some an instrument for the advancement of mankind. I shall be prepared to accept that belief when it is shown that cancer has a perfecting influence on the human organism and that fleas evolve the dog.

Great as is the damage done by dictatorships in keeping the war spirit alive for political and personal ends, it is nothing beside the damage from their interference with the individual and family life within their borders. Let us consider the family life for a moment. Normally, human beings desire such a life, but a healthy domestic life is possible only under certain conditions. Those of us who are descended from old colonial houses, in which the number of offspring sometimes ran to ten or twenty to the family, have been wont to imagine those as the good old patriarchal days when each man's "quiver" was full of sons and daughters, and if he did not sit under his own vine and fig tree it was due to climatic rather than economic considerations. But geneticists who have probed into the idyllic homes of our ancestors have found that the extent of unoccupied land and the communal character of the farming life of the period made children an asset, and that to bring many of these families into existence exacted the lives of several mothers. It does not follow that a family life even as limitedly satisfactory as that could be built up in a highly industrialized community. How even the supposed advantage of a numerous family may be abused under somewhat analogous conditions was brought vividly to my attention in one of the more backward parts of our country. There I learned that it was the practice of farm owners to rent land by preference to families with large numbers of children so that there would be more unpaid labor available, and it was intimated that parents increased the numbers of their children with an eye to this tendency. Whatever immediate advantage the farm owner and the parents may have derived from such exploitation of childhood, it could only be damaging to the community as a whole, and probably made problems for society to face at a later day.

If the sexes were precisely even numerically and all individuals married, and all the children grew up to have offspring in their turn, each family must then have one son and one daughter on an average merely to renew the population of the globe. We know, of course, that that condition never has occurred, nor will it ever occur. The wastage of life is such, coupled with voluntary and involuntary celibacy, that families that reproduce might perhaps average from four to six children in order to keep the population normal. If you review in your minds how many families of your acquaintance have from four to six children and how much time and care the proper rearing of children demands—those of you who have had experience with them—you will shed no tears over the cries of distress from so-called overpopulated countries "in need of more territory," especially when it is remembered that those states which wail most bitterly are the ones which subsidize childbirth and put a ban on family limitation. Mass production of infants can be intended only to aggrandize the power of a state and fill the ranks of its armies.

It is doubtful, however, whether such high-pressure methods of creating potential cannon-fodder will succeed. It is rather probable that this will prove another case of the sacrifice of quality to quantity. In spite of the failures of so many families, no device has yet been found for the raising of more efficient children apart from family control and guidance. It is probable that each family has an optimum level for the rearing of offspring, some functioning best with one, some with two and some with several, and some families performing their greatest uses to society without offspring. It is not a question of economic but of psychological and affectional adequacy. If government simply removes the environmental limitations to the proper functioning of a family, well and good, but when it goes beyond that it may overburden efficient parents and bribe inefficient parents to bring children into the world for which they can not care. The natural result of this state of affairs will be adoption of child-rearing by the state itself more and more, a custom also resorted to to protect the rising generation from "political heresy."

In assuming this attitude the state pretends that it has the higher good of its people at heart, but, in destroying the optimum family balance and breaking into the normal family life, it goes far toward destroying family happiness, and for this in the case of the ordinary citizen there can be no substitute, however successful the state as a whole may appear to be. A happy family life can not be harmonized with a life in which the parents are reduced to the status of studs. It is probable, furthermore, that the state will sacrifice in the long run the very advantage which it sought. You can not interfere with the delicate structure of family life and parental affection and raise men and women to be cogs in a machine without endangering their utility for anything else. And the ultimate successes of nations are due, not to the adjustment of parts to a predetermined pattern but to the ability of its citizenry to meet successfully conditions which are unprovided

for and unforeseen. A dictatorship which would endure must raise a new dictator, and the history of absolutism shows that no way has yet been found to select a succession of absolute monarchs guaranteed to maintain the level of the founder of the line.

You are all aware of the damage science has suffered in the highly regimented states. Every student in the realm of natural science would be justly indignant if he were told what deductions he must draw from his experiments before he began them, but over great areas of the world workers in the social sciences are, in effect, admonished in just this manner. Scholarship withers wherever and whenever it must subscribe in advance to a political, social or economic superstition. You are brought together here by the pursuit of truth, not to validate *Das Kapital* or *Mein Kampf*, and if you sacrifice the untrammeled pursuit of truth in one line of endeavor for a prescribed conclusion, there is the strongest likelihood that the perversion will spread to other disciplines and contaminate them all. Paradoxically, but not for the first time, only the martyrs will survive.

But fortunately, prejudice is a hothouse plant withered by the first breath of air from the great outdoors of truth. The cosmos is one and the world of mankind at heart is international. Interruption of the free flow of thought and the free flow of trade from nation to nation, mutual enmity, armaments, restrictive tariffs and monopolies damage most in the long run those responsible for them, and sooner or later they are doomed to pass away. In spite of the efforts of political, social or clerical groups to coerce the spirit of man, it has shown in all ages the capacity to resist and to reassert its freedom. To those emotional insanities which have for their object the curtailment of human liberty it has opposed the grander movements of the soul such as the social and ethical uplift which came with Christianity, the great revolutions of the eighteenth century and the emergence of the scientific approach. The morale which carried through those achievements was due to the fact that participants in them had a vision of truth and justice beyond that prevailing in the world about them, and a sense, too, that evolution and the course of history are, or can be made to be, upward processes. This is one reason why I object to that superficial materialism which would give mind a place secondary to matter, and why I refuse to regard the "heat-death" hypothesis as the last word in cosmic theory. The persistent climb of life up the evolutionary ladder, and, in spite of his numerous lapses, of mankind up the cultural ladder lead me to believe that decline is temporary and progress normal.

And now for one ultimate question. We may assume that evolution among the organisms below man was unconscious, but that is not true, not altogether true at least, of cultural advance. Why do we aspire? Why do we scientists pursue truth? Is it for the gratification of our curiosity? Or the mere interest of the quest, like the resolution of a crossword puzzle? Or is it for the material benefit of mankind, ourselves included? While all these play a part, I am inclined to think our feeling comes to be simply that it is good to penetrate more and more deeply beneath the veil of appearances and the veil of prejudice and orient ourselves more and more to the profounder realities.

The conscious attitude of some of you is no doubt essentially humanistic. You are engaged in congenial work in pleasant surroundings and among appreciative associates. Like Thoreau you are willing to waive questions of the hereafter with the thought, "One world at a time." You are willing to trust your immortality in the hands of the scholars who may come after you and let such good work as you do benefit future generations upon this material world without disturbing yourselves as to another. There are some, however, and I am numbered among them, who, while they may be satisfied sufficiently with their own immediate surroundings, are unwilling to contemplate as the entire story the fates which seem to have been allotted undeservedly to many about them. They would like to regard themselves as inhabitants of a cosmos which, after all, and in the final summing up, is just, and, what is another way of saying the same thing, they would like to feel that this enterprise of life upon which we have been embarked without any volition on our part, is a worth-while process. They would like to think of it as something more than an endless procession of life out of and into the dark.

OBITUARY

EDMUND BEECHER WILSON
1856–1939

IT is given to few men to exert so great an influence in their chosen field of scientific research and also to attract so many friends over a much wider range of interest. The beauty of Wilson's workmanship and the balanced judgments of his decisions are two of his outstanding accomplishments. In the discussions of the broader aspects of the problems, connected with his researches, his careful consideration of the pros and cons might lead one who did not know him personally to infer that he held no very definite opinions in the wider philosophical fields of speculation. On the contrary, he had very strong predilections, but he had so thoroughly trained himself to control his personal opinions that he kept them well in hand.

Perhaps Wilson's outstanding contribution was in the field of cell-lineage, following the classical studies of Whitman. Work of this kind is extremely laborious, requiring the most meticulous attention to details, but Wilson never lost sight of its broader aspects. He soon became one of the outstanding leaders in cytology, as the study of the cell came to be called. His researches and wide reading of the literature culminated in the final edition of his fine book on "The Cell in Development and Heredity," to the writing of which he devoted more than twenty years. Cytology in his hands covered a broader field than the traditional histology. In fact, it became a search for the factors or causes, starting with the primordial cell—the egg—that are at work during development bringing about the segregation of groups of cells into organs and their subsequent histological and functional specialization.

Later when other methods came into vogue for studying the developmental problems of the egg by cutting the egg into fragments or by separating the blastomeres —a procedure that traces back to Chabry, Roux and Driesch—Wilson with a more thorough background of cell-lineage made outstanding contributions both factual and theoretical. The fundamental problem at stake, which is spoken of in general terms as "the organization" of the egg, is still with us. It has, I think, become more apparent that the many attempts that have been made to interpret the organization of the egg are futile until organic chemistry furnished us with more information as to the properties of proteins, their catalysts and the reconstructive properties of living protoplasm. Nevertheless, the descriptive and experimental work of embryology has made clear the kind of problems involved.

Wilson added greatly to our knowledge of the chromosomes and especially to their behavior during the maturation of the germ-cells. The beauty of fine preparations appealed to his artistic sense. His interest and leadership in this field led to two important discoveries. One of his students, W. S. Sutton, was the first to point out that the manoeuvers of the chromosomes furnish the mechanism for Mendel's two laws of heredity. The other discovery, following an earlier suggestion of McClung, was made independently by Miss N. M. Stevens of Bryn Mawr and Wilson of Columbia, namely, the rôle of the sex-chromosomes or the X-chromosomes, as Wilson called them, in the determination of sex. These discoveries prepared the way for the interpretation of sex-linked inheritance that has played an important rôle in modern genetics.

Wilson's death will be felt deeply by his many friends and admirers. His scientific career was well rounded out and was, in a sense, complete. Few men have accomplished as much, and one may well envy him the great joy he had in carrying on his work and the enthusiasm that he imparted to a host of colleagues, students and friends.

THOMAS HUNT MORGAN
CALIFORNIA INSTITUTE OF TECHNOLOGY

SAMUEL STEEN MAXWELL

SAMUEL STEEN MAXWELL was born of Scotch-Irish parentage at Manor-cunningham, County Donegal, Ireland, on August 4, 1860. He died in Berkeley, California, on January 28, 1939.

Dr. Maxwell's ancestry has been traced to Max, son of Unwin, who settled near the Tweed in Scotland about 1160. His immediate family settled in the midwest of the United States when he was still a young boy.

After taking a B.S. degree at Amity College, Iowa, in 1886, he remained another three years at his alma mater, instructing first in mathematics, later in natural science and in the meantime working for an M.S., which was awarded him in 1888. Summers were devoted to instruction in the Iowa Teachers' Institutes. He married Lula Beatrice Taylor, of Lovelace, Kentucky, on June 30, 1887. His widow and three of his four children survive him.

A year of graduate work at the Johns Hopkins in 1889–90 was followed by a professorship in biology at Monmouth College, Illinois. Here he remained for the next twelve years, except for an interval of two years spent in graduate work under Jacques Loeb at the University of Chicago, where he obtained his Ph.D. in 1896. His thesis on the physiology of the annelid brain was published in *Pflüger's Archiv*. For two years Monmouth College was without a president, and during this period Dr. Maxwell served on the board of administration, and at the same time he edited the college magazine.

In 1902 he left the Midwest on a fellowship in physiology at the Harvard Medical School and remained on for two years as instructor. In 1902, Loeb left Chicago for the far West to head the division of physiology at the University of California. The rooms assigned to him in the old East Hall were inadequate for the school of experimental physiology which Loeb wished to establish, but when the Spreckels Physiological Laboratory was built on a knoll overlooking the beautiful Faculty Glade, it was equipped with special aquaria for experimentation on marine invertebrates, and there was space enough for mammalian experiments and biochemistry as well. Dr. Martin Fischer, one of Loeb's pupils, had gone with him from Chicago to serve as instructor, and when Fischer accepted the professorship of pathology at the Oakland College of Medicine and Surgery in 1905, Dr. Maxwell was brought from Harvard to take his place.

Dr. Maxwell remained at the University of California for the rest of his life, rising gradually through the various ranks from instructor to professor. When Loeb went to the Rockefeller Institute in 1910, biochemistry was split off from physiology and Dr. Maxwell was made chairman of the division of physiology. Except for an interval of four years, he continued to hold this position until his retirement.

At the time of Dr. Maxwell's arrival in California the activity in Loeb's laboratory was intense. The subject upon which all the workers were concentrating their attention was temperature coefficients of physiological reactions. Martin Fischer had investigated the effect of heat on the beat of the crab's heart, and Dr. Theodore Burnett, at that time a volunteer in the laboratory, was assisting Loeb in similar experiments on the rate of conduction of the nerve impulse in the huge garden slugs found on the campus. For this purpose Loeb had had an expert machinist construct an elaborate piece of apparatus of shining polished brass and ebonite, which, unfortunately, proved useless. Loeb in disgust turned the problem over to Dr. Maxwell as soon as he arrived. Dr. Maxwell merely soldered a few wires to a discarded candy tin, and solved the problem in short order. This was typical of Dr. Maxwell's experimental methods. Simple, home-made gadgets to supplement the ordinary physiological apparatus in his hands brought results.

Dr. Maxwell's early papers were along lines similar to Loeb's, *e.g.*, the effect of salts on ciliary activity, chemical stimulants of the cerebral hemispheres, etc. He wrote a popular article on Loeb's experiments in chemical fertilization, and with Loeb wrote on heliotropism in plants and animals.

It was, however, not until 1919 that he began the work on the labyrinth with which his name is always associated. Loeb founded the *Journal of General Physiology* in 1918, and in the second volume appeared two articles by Dr. Maxwell, (1) "Comparison of the Otolith Organs and of the Semicircular Canals" (2) "The Mechanism of the Dynamic Functions of the Labyrinth." This was the beginning of a series of papers which in 1923 were summed up in his book "Labyrinth and Equilibrium" in the series of monographs on experimental biology sponsored by Loeb, Morgan and Osterhout. This was the first, and for some time, the only volume on vestibular function in English. The conclusions drawn were based almost entirely on experiments on the dogfish, but by inference they have been considered to apply to mammals and have been incorporated in many texts of physiology for medical students. Until 1930, when Creed translated Canus's "The Physiology of the Vestibular Apparatus," Dr. Maxwell's book was the authority on this subject.

Shortly after his retirement Dr. Maxwell suffered partial paralysis which affected both speech and muscular movements. However, he made fairly good recovery and for several years was able to go about with the use of a cane, and his speech, although slow, had suffered no other impairment. Death was caused by a second stroke.

Dr. Maxwell's name will always be associated with that of Loeb in the scientific work which came out of the Spreckels Physiological Laboratory of the University of California during the early years of this century and for his careful experiments on the inner ear of the dogfish.

J. M. D. OLMSTED

UNIVERSITY OF CALIFORNIA
MEDICAL SCHOOL,
BERKELEY

RECENT DEATHS

DR. ARTHUR EDWARD HILL, professor of chemistry in the College of Arts and Pure Sciences of New York University and head of the department of chemistry, died on March 16 at the age of fifty-eight years.

DR. IRVING GILMAN DAVIS, professor of agricultural economics and chairman of the department of economics of Connecticut State College, died on March 15 at the age of fifty-four years.

DR. FRANK PARSONS NORBURY, since 1913 superintendent of the Norbury Sanatorium at Springfield, Ill., died on March 15 at the age of seventy-five years.

DR. LEONARD HALFORD DUDLEY BUXTON, since 1928 reader in physiological anthropology at the University of Oxford, fellow and bursar of Exeter College, died on March 6. He was forty-nine years old.

SCIENTIFIC EVENTS

THE IMPERIAL BUREAU OF DAIRY SCIENCE

IN 1936 the British Commonwealth Scientific Conference, which met in London to consider the working of the organizations controlled by the Executive Council of the Imperial Agricultural Bureaux, recommended that a new Imperial Bureau of Dairy Science be established. The conference also suggested the National Institute for Research in Dairying as the most suitable location for the bureau.

Following agreement by all the authorities concerned the new Imperial Bureau of Dairy Science has now been established at Shinfield, near Reading. Professor H. D. Kay, director of the National Institute

for Research in Dairying, has been appointed director of the bureau. W. G. Sutton, Massey Agricultural College, New Zealand, has been appointed deputy director and has now taken up his duties. The bureau is financed cooperatively by the governments of the British Empire in the same way as the other Imperial Agricultural Bureaux.

The functions of the bureau are to index research work in dairy science, whether carried out in the Empire or elsewhere; to collect, abstract and collate information bearing on dairy science and to distribute such information both by publication and by private communication to research workers, officials and advisory officers throughout the Empire. In addition the bureau is charged with the duty of establishing and maintaining contact between research workers with common interests, promoting conferences of workers and visits to research centers, and in general encouraging the circulation of information ideas, material and personnel.

The field of dairy science to be covered by the bureau was defined by the conference when recommending its establishment. This field includes the microbiology, chemistry and physics of milk and its products; animal diseases in so far as they affect milk and its products; the technology of processing milk and manufacturing dairy products; the physiology of milk secretion as affecting quality and quantity of milk and dairy products; standards for the composition and quality of milk and its products.

The routine work of the bureau, such as indexing and abstracting, will already be familiar to many dairy workers from the activities of the bureaus already established in other subjects. An aspect of bureau work which may not be so well known and understood is the more informal service which can be given to research workers, teachers and field officers. The bureau aims to be the friend of these dairy workers. It will deal directly with the individual workers in dairy science, who are invited to write to the bureau for information which is not obtainable in their own countries. It may be able to supply the information or to put the inquirer in touch with some one who can do so more effectively.

SCHOLARSHIPS OF THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY AT THE CARNEGIE INSTITUTE OF TECHNOLOGY

THE cooperative engineering educational plan of the Carnegie Institute of Technology, in cooperation with the Westinghouse Electric and Manufacturing Company, which enables a student to obtain practical experience in Westinghouse plants during five summer vacations and two college semesters as well as to complete eight semesters of college class work, was made possible by the appropriation of $200,000 by the Westinghouse Company in 1937. Last summer the first ten scholarship students were elected.

When in complete operation, the scholarship course will include fifty students, with ten scholarships becoming vacant each summer. A scholarship has a value of $3,000 and is awarded to a student of exceptional ability, final selection being based on results of competitive examinations, character and personality. Applications for the second scholarship class must be received before April 1.

D. F. Miner, George Westinghouse professor of engineering at the institute, who as coordinator of the cooperative program supervises the scholarship holders, points out that the plan affords an unusual opportunity for combining theoretical training with practical experience. At the age of twenty-two to twenty-four, the participants will have completed a four-year formal engineering course and, at the same time, will have acquired a substantial background of two years' industrial experience.

W. G. Marshall, vice-president of the Westinghouse Company, states that through this opportunity in engineering education the Westinghouse Company "confidently expects to guide the development of a group of young men who will become industrial engineering and business leaders of the future. The first year of operation of the plan has met with wide success, and it is anticipated that even greater accomplishments by the students will be evidenced during the coming year."

Last year the scholarships were awarded to the ten highest ranking students among 293 applicants. The successful students came from states as widely separated as Montana, Pennsylvania, Washington, Ohio and New Jersey.

GRANTS OF THE COMMONWEALTH FUND IN AID OF MEDICAL RESEARCH

THE twentieth annual report of the Commonwealth Fund states that in trying to advance public health the fund has found no better way than "to help schools to teach and doctors to learn the best contemporary medicine." Appropriations for this purpose through various channels reached the sum of approximately $375,000 in 1938. As a new element in this program, the ten fellowships were awarded to junior instructors in medical schools, on nomination of their department chiefs, not only to give promising young men an opportunity for professional growth but to strengthen the teaching resources of the schools where they are at work. This offer, it was announced, will be continued. Similar fellowships were given to four junior staff men interested in the teaching of pediatrics to enable them to study psychiatry as an aid to the better handling of children.

Other new awards of the year included subsidies to the departments of preventive medicine at New York University and the Long Island College of Medicine. At each of these schools fourth-year students will work in district health centers of the New York City Health Department. Grants to Tulane, Vanderbilt and Tufts, also for the teaching of preventive medicine, were continued from previous years, together with a subsidy to the department of psychiatry at the University of Louisville. The fund assisted in the postgraduate teaching of medicine at Harvard, Vanderbilt, Tulane and the University of Minnesota, and offered fellowships to men in country practice in seven states.

Funds amounting to more than $345,000 were set aside for medical research at fifteen different medical schools and hospitals. Judging each appeal on its merits, the fund has nevertheless concentrated its subsidies to some extent in groups of related studies at different centers. Thus in the field of heart and kidney disease it reported grants to the University of Pennsylvania for the study of kidney function, to the Johns Hopkins for the study of essential hypertension, to Western Reserve University for work on chronic nephritis and the causes of heart failure, and to Yale for a general investigation of the causes of circulatory disease. A study of arthritis at the Massachusetts General Hospital, Boston, and three studies of rheumatic fever were aided, together with three on problems of growth and development in childhood. New appropriations in the field of the acute communicable diseases included two to the University of Pennsylvania for the study of air-borne infections and the chemical structure of the streptococcus.

GRANTS OF THE GEOLOGICAL SOCIETY OF AMERICA

THE Geological Society of America announces that the following grants in support of special research problems have been authorized by the council:

W. H. Twenhofel, Madison, Wis., $1,440. Professor Twenhofel will return to Newfoundland this coming field season. With an assistant he will extend studies begun in 1935 along the coast and islands of Notre Dame Bay and along the Exploits River, and continued in 1936 in the White Bay region. Plans for the new work call for examination of the interior, the more inaccessible parts of which will be reached by airplane. Professor Twenhofel has been assured of the active cooperation of Dr. A. K. Snelgrove, government geologist of Newfoundland. The studies will include not only the stratigraphy but the physiography and glacial geology as well.

R. Dana Russell, Baton Rouge, La., $1,800. Professor Russell will study sediments off the mouth of the Mississippi River in the Gulf of Mexico. The Bureau of Fisheries will cooperate by furnishing the use of the ship *Pelican*, and the Geological Society is financing the construction of 2 Piggot "Guns," the original of which was developed in 1935 with the aid of a grant from the society. Dr. C. S. Piggot, of the Geophysical Laboratory, will join the expedition.

V. Tanner, Helsingfors, Finland, $2,500. Dr. Tanner has for a quarter of a century been studying the late Quaternary changes in level in Fennoscandia and related areas in Europe. In the summer of 1937 he visited Newfoundland and Labrador and became convinced of the possibility of correlating changes of level in Labrador with those in Fennoscandia through a detailed study of raised beaches and other phenomena. The grant from the Geological Society will enable him to extend his investigations to the coast of Labrador.

Randolph W. Chapman, Huntington, W. Va., $540. Dr. Chapman and his brother, Dr. Carleton A. Chapman, of the University of Illinois, will make a detailed petrographic and structural study of Mt. Starr King and the surrounding region in northern New Hampshire. The two Chapmans have taken an active part in the detailed mapping and study of the geology of New Hampshire conducted during recent years under the supervision of Professor Marland Billings. The White Mountain magma series, the question of cauldron subsidence, laccolithic intrusions and the Ammonoosuc thrust fault will be investigated.

Chester Stock, Los Angeles, Calif., $1,800. With the assistance of Dr. L. R. David, Dr. Stock will conduct a study of Tertiary fossil fish faunas of the Pacific Coast, involving taxonomy, comparison of morphological characters, distribution on the Pacific Coast of North America and the significance of fossil fishes in related geological problems, such as correlation of marine sediments and conditions of sedimentation in the area involved.

W. H. Newhouse, Cambridge, Mass., $1,160. Professor Newhouse will devote the coming summer to field studies of selected mineral deposits with view to following out evidence already in hand that the direction of flow of the ore-bearing solutions can be determined from mineral symmetry. Whether the deposit is a filled vein or a replacement body, the criteria already developed appear to be useful in solving problems in ore deposition.

Robert T. Hill, Dallas, Texas, $1,800. Dr. Hill's studies cover the history of geologic investigation in the Southwest, including identification and interpretation of the routes of Cabeza de Vaca and Coronado. A volume is expected to result from these studies.

Roger Revelle, La Jolla, Calif., $900. Dr. Revelle, of the Scripps Institution of Oceanography, will continue his studies of recent marine sediments from various localities between Panama and Alaska that have been sampled by the Institution, by the U. S. Coast and Geodetic Survey and by the Navy. Many of the samples consist of cores taken with the Varney-Redwine coring instrument recently developed at the Scripps Institution. The mechanical analyses of sediments that pass a 230-mesh screen are to be made from a sodium carbonate suspension by taking pipette samples at intervals of time corresponding to the Wentworth size grades down to 0.5 microns in equivalent particle diameter. The results will give the particle size distribution and organic content, the relationship between size distribution and topography, and changes in environ-

mental conditions occurring during relatively recent geologic time. The coarser separates will be preserved for petrographic and micropaleontologic studies.

A. K. Miller, Iowa City, Iowa, $600. Arrangements have been made for Dr. Miller to complete the studies long in progress by Dr. E. O. Ulrich and the late Dr. Aug. F. Foerste of Ozarkian and Canadian cephalopods, and to complete the manuscript for publication. Dr. Miller will be assisted in the work by Dr. W. M. Furnish.

THE PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-third annual meeting of the Pacific Division of the American Association for the Advancement of Science will be held this year at Stanford University from June 26 to July 1. The general sessions will be held on Tuesday, June 27, and will begin with a symposium on "Radiation and Life." The speakers will be Dr. W. V. Houston, of the California Institute of Technology; Dr. John H. Lawrence, of the University of California; Dr. M. Delbruck, also of the California Institute of Technology, and Professor Robert R. Newell, of Stanford University Medical School. A session on reviews of current research will be held in the afternoon. Professor J. W. McBain, of Stanford University, will speak on "Recent Advances in Colloid Chemistry," and an address by Dr. A. R. Davis, of the University of California, will follow. Professor Henry Borsook, of the California Institute of Technology, will contribute a discussion of "Biological Oxidations and Reductions," and Dr. J. W. Macfarlane, of the University of California, will discuss "Research on Personality Development." A general reception for members and guests of the division and its associated societies will follow the meeting. Among the evening addresses will be that of the president of the Pacific Division, Professor S. J. Holmes, of the University of California, on "Darwinian Ethics and Its Practical Applications." Professor John Desmond Bernal, professor of physics at Birkbeck College, the University of London, will also deliver one of the evening addresses.

Seventeen scientific organizations on the Pacific Coast are participating actively in the meeting by holding scheduled sessions throughout the week, while members of associated societies not formally participating are invited to take part by attending or presenting papers at the scheduled sessions. Titles of papers may be sent to the office of the Secretary, Pacific Division, American Association for the Advancement of Science, Stanford University, up to May 3, or, if sent to the secretaries of affiliated societies, the closing date for their inclusion in the program is April 29.

The meeting of the Pacific Division will be followed by a symposium commemorating the enunciation of the cell theory (July 1 to 5), and by the sixteenth National Colloid Symposium (July 6 to 8). Both will be held at Stanford University.

SCIENTIFIC NOTES AND NEWS

AT the annual meeting in Philadelphia of the American Association of Physical Anthropologists a dinner will be given on April 4 at the Hotel Pennsylvania in honor of the seventieth birthday of Dr. Aleš Hrdlička, curator of the Bureau of Anthropology of the U. S. National Museum. Dr. Hrdlička was born in Bohemia on March 29, 1869.

ACCORDING to a cablegram from England, Dr. C. E. Kenneth Mees, director of the research laboratories and vice-president of the Eastman Kodak Company, was nominated on March 16 for fellowship in the Royal Society, London.

THE International Acetylene Association recently awarded the James Turner Morehead Medal to John J. Crowe, research engineer of the Air Reduction Sales Company, New York. The medal was presented at the convention of the association, which met at Houston, Texas, from March 8 to 10. It was awarded to Mr. Crowe "in honor of his unceasing and successful technical activities," particularly in the development of apparatus for oxyacetylene welding and cutting.

DR. ADOLF WINDAUS, professor of chemistry at Göttingen, has been awarded the Pasteur Medal of the Society of Biological Chemistry at Paris.

THE Mary Kingsley Medal of the Liverpool School of Tropical Medicine has been awarded to Dr. Werner Schulemann, professor of pharmacology at the University of Bonn.

IT is announced in *Nature* that G. Ingle Finch, professor of applied physical chemistry at the Imperial College of Science and Technology, London, was presented at the Belgian Embassy on January 23 with the order of Commander of the Order of King Leopold II, which was conferred on him by King Leopold III for services rendered to science in Belgium during his term of office as Fondation Francqui professor in the University of Brussels during 1937–1938. Dr. Otto Loewi, professor of pharmacology at the University of Graz, was recently appointed his successor.

DR. ALFRED VOGT, professor of ophthalmology at the University of Zurich, has received the Cothenius Medal of the Academy of Natural Sciences at Halle.

THE hundredth anniversary of the birth of Ludwig Mond, the distinguished English industrial chemist, occurred on March 7.

DR. S. W. RANSON, director of the Institute of Neurology of the Medical School of Northwestern University, has been elected a corresponding member of the Society of Neurology of Paris.

THE retirement is announced of Dr. Albert H. Wilson, professor of mathematics at Haverford College, who has been a member of the faculty for twenty-nine years.

PROFESSOR F. J. COLE retired in September from the chair of zoology at the University of Reading, which he had held for thirty-two years.

DR. ERWIN FINLAY FREUNDLICH, formerly professor in the German University at Prague, has been appointed Napier lecturer in astronomy and director of the new Astronomical Observatory in the United College of St. Andrews.

DR. CARL WILHELM CORRENS, of Rostock, has been appointed professor of mineralogy and geology at Göttingen.

DR. FREDERICK C. LEONARD, chairman of the department of astronomy of the University of California at Los Angeles, will be visiting professor of astronomy in the summer session of the University of British Columbia, Vancouver, which will be in session from July 3 to August 18, and Dr. Daniel Buchanan, dean of the Faculty of Arts and Science and head of the department of mathematics of the University of British Columbia, will be visiting professor of astronomy and mathematics in the summer session at Los Angeles, from June 26 to August 4. A similar exchange was made in the summer of 1937.

DEPUTY COMMISSIONER CHARLES E. JACKSON has been appointed Acting Commissioner of Fisheries to discharge the duties of the Commissioner of Fisheries until such time as an appointment is made to fill that position. The resignation of Commissioner Frank T. Bell was accepted by the President on January 7.

DR. G. E. HILBERT, senior chemist in the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, has been appointed scientific adviser, with headquarters at Washington, D. C., in the general organization of the Regional Research Laboratories, which are being established by the department.

DR. C. K. LEITH, professor of geology at the University of Wisconsin, has been reappointed by Secretary Hopkins a member of the Business Advisory Council to the U. S. Department of Commerce. Professor Leith is also chairman of the Minerals Advisory Committee to the U. S. War and Navy Departments, acting through the Army and Navy Munitions Board.

DR. WENDELL S. NIEDERHAUSER, assistant professor of chemistry at Williams College, has resigned to take a position as research chemist with the Rohm and Haas Company, of Philadelphia.

THE Jacob Wertheim Fellowship for the Betterment of Industrial Relations has been awarded by Harvard University to Anthony Luchek, of the University of Michigan, to enable him to complete a study of labor conditions in the automobile industry. The fellowship, with an endowment of $100,000, was established in 1923.

THE Commonwealth Fund has granted the sum of $8,360 to the Institute of Pathology at Western Reserve University to be expended over the course of a year in support of the studies on the chemistry of immunity of Dr. E. E. Ecker, associate professor of immunology and immunologist to the University Hospital. Provided progress is made, a similar appropriation will be made for an additional two years.

THE Rockefeller Foundation has made a grant of $2,000 to continue for the year 1939 the studies in malaria conducted by William H. Taliaferro, chairman of the department of bacteriology and parasitology and dean of the Division of the Biological Sciences of the University of Chicago.

THE National Committee for Mental Hygiene will give an additional grant of $1,000 to aid in the research in dementia praecox being carried on by Drs. Esther Bogen Tietz and Douglas Goldman, at Longview Hospital, Cincinnati.

DR. JOHN A. LANFORD, assistant professor of surgical pathology at Tulane University, has been elected a member of the board of directors of the American Society for the Control of Cancer.

DR. DUGALD C. JACKSON, professor emeritus of electrical engineering at the Massachusetts Institute of Technology, lectured on March 15 at the Franklin Institute, Philadelphia. The title of the lecture was "Man in an Engineering World." At this meeting presentation of the Boyden Premium was made by the institute to Dr. John S. Hall, of the Amherst College Observatory.

DR. HENRY B. WARD, of the University of Illinois, gave an illustrated lecture on March 8 at the Illinois State Museum on "Salmon Psychology and its Relation to Conservation." The lecture was one of the winter series sponsored by the museum.

DR. ENRICO FERMI, professor of physics at Columbia University, gave an illustrated lecture on "The Mesotron" at a joint meeting on March 16 of the Washing-

ton Academy of Sciences and the Philosophical Society of Washington.

THE Edward K. Dunham Lectures for the promotion of the medical sciences were given on March 8 and 10 at Harvard Medical School by Dr. K. Linderstrøm-Lang, of the Carlsberg Laboratory, Copenhagen. The titles of the separate lectures were: "Micromethods for the Determination of Enzymes," "Distribution of Enzymes in Cells and Tissues" and "Proteins and Proteolytic Enzymes." He lectured on March 21 at the Franklin Institute under the auspices of the Biochemical Research Foundation on "The Histo-chemistry of Cells."

DR. THOMAS M. RIVERS, director of the Hospital of the Rockefeller Institute for Medical Research, will deliver five Lane lectures at the School of Medicine of Stanford University during the week beginning on May 22. The subjects of the lectures will be: "Lymphocytic Choriomeningitis," "Pathology of Virus Diseases," "Immunological and Serological Phenomena of Virus Diseases," "The Nature of Viruses" and "The Treatment and Prevention of Virus Diseases."

THE fourth annual science forum lecture at Mundelein College, Chicago, will be given on April 18 by the Reverend Alphonse M. Schwitalla, S.J., dean of the Medical School of St. Louis University. His subject will be "Schwann and a Century of Scientific Progress." The lecture will commemorate the one hundredth anniversary of the publication of the cell theory.

DR. HOWARD C. NAFFZIGER, head of the division of surgery of the Medical School of the University of California and president of the American College of Surgeons, has been invited to make an address on the occasion of the celebration on May 4 of the anniversary of the founding of the Medical School of the Johns Hopkins University.

DR. FRANCIS G. BENEDICT, formerly director of the Nutrition Laboratory of the Carnegie Institution of Washington at Boston, lectured at Notre Dame University, Indiana, on March 13 and 14. The first was an illustrated lecture on animal metabolism, "From the Mouse to the Elephant." The second was entitled "Science and the Art of Deception."

THE regular spring meeting of the Pennsylvania Academy of Science will be held on April 7 and 8 at the Pennsylvania State College, Pa. Information concerning the meeting can be obtained from the secretary, Dr. V. Earl Light, Lebanon Valley College, Annville, Pa.

THE fourteenth scientific sessions of the American Heart Association will be held on May 12 and 13 at the Hotel Jefferson, St. Louis, Mo. The general cardiac program will be given on Friday, May 12, and the program of the Section for the Study of the Peripheral Circulation on Saturday, May 13.

THE tenth spring meeting of the Eastern Psychological Association will be held at Bryn Mawr College on March 31 and April 1, under the presidency of Dr. Karl M. Dallenbach, of Cornell University.

THE American Institute of Nutrition will meet in Toronto on April 26. The morning and afternoon sessions will be devoted to the presentation of papers on current nutrition research. The evening will be given over to a symposium entitled "The Fortification of Foods with Vitamins and Minerals," Dr. E. V. McCollum, professor of biochemistry and head of the department of school hygiene and public health of the Johns Hopkins University, presiding. The program follows: "Basic Nutrition Principles Involved in the Fortification of Foods," Agnes Fay Morgan; "Fortification of Foods in a General Program for Better Nutrition," Lydia Roberts; "Public Health Aspects of Fortification of Foods," W. H. Sebrell; "Governmental Control Problems in the Fortification of Foods," E. M. Nelson, and "Viewpoints of the Food Industries Regarding Fortification," Alonzo Taylor.

DURING the current academic year the department of geology of Bryn Mawr College has conducted a symposium on the problems of the crystalline rocks of the Piedmont Province of the eastern United States. Lectures and field excursions for a selected group of graduate students have been conducted by Professors E. H. Watson and Dorothy Wyckoff. During January and February a series of lectures by workers in this field has been given. The lecturers and their subjects were: G. W. Stose, U. S. Geological Survey, "The Geology and Structure of the Reading Hills, Pa."; Dr. Anna Jonas Stose, U. S. Geological Survey, "The Geology and Structure of the Western Piedmont of Maryland"; Dr. Anna Hietanen, University of Helsinki, Finland, "Orientation of Quartz and Mica in the Wissahickon Schist of the Philadelphia Region"; Dr. Ernst Cloos, the Johns Hopkins University, "Recent Work on the Geology and Structure of the McCalls Ferry-Quarryville Quadrangles"; Dr. Marland P. Billings, of Harvard University, "Metamorphism in Western New Hampshire and Eastern Vermont"; Dr. Robert Balk, Mount Holyoke College, "Problems of Metamorphism in Southeastern New York"; Dr. Eleanora Bliss Knopf, Yale University, "The Role of Mineralogic and Tectonic Facies in Metamorphism."

THE Eastern Regional meeting of the Pennsylvania Junior Academy of Science was held on February 24 under the auspices of the Steinmetz Scientific Society of the Upper Darby Senior High School. Over a

hundred and fifty high-school students of science were in attendance, with fifteen science clubs represented. Eleven student papers were presented. There was an attendance of a hundred and ten at the dinner in the evening, at which Dr. Richard M. Sutton, of Haverford College, was the speaker. The Western Regional meeting was held on March 4, under the auspices of the Biology Club of Peabody High School, Pittsburgh, Pa. Thirteen clubs were represented by two hundred and twenty-five boys and girls. The attendance at the dinner was a hundred and forty. Dr. L. K. Darbaker, of the University of Pittsburgh, president of the Pennsylvania Academy of Science, and Dr. Karl F. Oerlein, Teachers College, California, Pa., general chairman of the Pennsylvania Junior Academy of Science, spoke at the morning session. Fourteen student papers were presented.

YALE UNIVERSITY has received from the Rockefeller Foundation a grant-in-aid of $189,000 toward the continued support of the Yale Laboratories of Primate Biology for the five-year period July 1, 1939, to June 30, 1944, and also the sum of $35,000 for the construction of an additional laboratory building at the Anthropoid Station at Orange Park, Florida. Under the reorganization of the laboratories, following the ten-year period for which the project was originally financed, the director, Dr. Robert M. Yerkes, will be responsible to an administrative committee, serving as a board of control. The following have been appointed members of this committee: Drs. Carl G. Hartman, research associate in embryology, Carnegie Institution, the Johns Hopkins School of Medicine, *chairman;* Edgar Allen, professor of anatomy, Yale School of Medicine; Leonard Carmichael, president of Tufts College; William H. Taliaferro, dean of the Division of Biological Sciences, University of Chicago; Robert M. Yerkes, professor of psychobiology, Yale School of Medicine, *secretary,* and, as member *ex-officio,* Stanhope Bayne-Jones, dean of the Yale School of Medicine.

CANDIDATES for the Jacksonian professorship of natural philosophy at the University of Cambridge, which is vacant owing to the resignation of Professor E. V. Appleton, of St. John's College, to accept the secretaryship of the Scientific and Industrial Research Council, should communicate with the vice-chancellor of the university before April 11. The professorship is assigned to experimental atomic physics and will be associated with the Cavendish Laboratory.

IT is stated in *Nature* that a large plaster-of-Paris model of the main new buildings of the Academy of Sciences of the U.S.S.R. is now on view at the Academy's premises in Bolshaya Kuluzhskaya Ulitsa in Moscow. The buildings were designed by A. V. Shchusev. The site for the buildings most favored is on the Frunze Embankment of the Moscow River. The new buildings of the academy, according to the plans, consist of five blocks with a volume of 880,000 cubic meters. In the center of the architectural ensemble is the main block for the presidium of the academy. The hall is large enough to seat 2,000 persons. There are also four smaller auditoriums. Near the main hall are rooms for the demonstration of films and for broadcasting; also a post and telegraphic office and an information bureau. A block has been set aside for the library and storage premises for fifteen million volumes. On either side of the block for the presidium are buildings to accommodate two museums, one of which will be the Natural History Museum.

DISCUSSION

NUCLEAR AND CYTOPLASMIC EFFECTS OF ULTRA-VIOLET LIGHT

THE bactericidal and photolethal effects of ultra-violet light have been known for a long time,[1] but the mode of action of the radiations is still obscure, although many interesting clues have been uncovered. Among the most interesting is the fact that the reciprocal of the curve of bactericidal action at different wave-lengths is suggestive of the absorption curve of the nucleoproteins, a fact which led Gates[2] to propose that the seat of action of ultra-violet light may be in the nucleoproteins of the cell.

If the lethal effect of ultra-violet light is indeed correlated chiefly with the effects upon nuclear constituents, then one might suppose that the isolated nucleus should be far more sensitive to the radiations than a nucleus surrounded by cytoplasm. Sperm are almost naked nuclei; they should serve as convenient material for just such a test. Therefore in one series of experiments the sperm of the sea urchin *Strongylocentrotus purpuratus* were irradiated, then used to inseminate unirradiated eggs; in another series of experiments the eggs were irradiated 30 minutes after insemination. In both cases, following the smaller dosages, division was retarded; following larger dosages, it was irregular; and if the dosage was large enough, abnormal. The results will be reported in detail later. In these studies known intensities of 2654A, a wave-length near the region of maximal absorption by the nucleoproteins[3] was used; the apparatus was essentially like that previously described.[4]

The point of greatest interest in these data, how-

[1] Duggar, "Biological Effects of Radiation," Vol. II, Ch. 36, 1936.

[2] Gates, SCIENCE, 68: 479, 1928.

[3] Heyroth and Loofbourow, *Bull. Basic Science Res.,* 5: 13, 1933.

[4] Giese and Leighton, *Jour. Gen. Physiol.,* 5: 535, 1935.

ever, is the fact that the amount of energy required to produce a given amount of retardation when the sperm was irradiated then used to inseminate an unirradiated egg was quite different from that required when the egg itself was irradiated. Thus in typical experiments a dosage of 50 ergs per mm² of incident energy given the sperm produced pronounced retardation, the first three divisions of the eggs inseminated with such sperm occurring two hours after the controls. A dosage of only 100 ergs given the sperm causes a delay of about 3 hours. A dosage as low as 300 ergs, given the sperm, causes irregular and abnormal development of the eggs inseminated with such sperm. On the other hand, a dosage of 50 ergs per mm² given the eggs caused only barely perceptible delay in division and a dosage of 816 ergs per mm² caused a retardation of the first three divisions of only about 1½ hours. The eggs will tolerate even 3,000 ergs per mm², cleaving slowly to form embryos.

These results indicate clearly the greater susceptibility of the sperm and therefore of naked nuclei to ultra-violet radiations. The nuclear material is present in the egg, but the radiations must pass through a thick layer of cytoplasm before reaching the nucleus. The greater resistance of the egg may be dependent upon the protection afforded by the cytoplasm to the nucleus. The radiations are unquestionably destructive to the cytoplasm[5] as well, but cytoplasmic injury is apparently less effective in retarding cell division than is injury to the sperm nucleus.

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A SPECIES OF AZOTOBACTER TOLERANT TO HIGH ACIDITY

ONE of the prominent characteristics of the aerobic, nonsymbiotic nitrogen-fixing bacteria, known as Azotobacter, is their sensitiveness to acid reactions. There is quite general agreement that pH 5.8 to 6.0 is the acid limit for growth in the absence of fixed nitrogen.[1] As stated by Burk and associates,[2] "The limit of fixation at pH 6.0 has been universally observed by all investigators." Even though Azotobacter has occasionally been recovered from mineral soils as acid as pH 4.5 and was reported as having been found in peat of pH 3.6,[3] there is no evidence that any of the isolated species of Azotobacter are able to develop upon nitrogen-free media which are more acid than the above-mentioned limit. Burk and associates[2,4] reported that the respiratory mechanism of Azotobacter is irreversibly destroyed by prolonged exposure to reactions below pH 5.0.

It is therefore of interest that there is a species of Azotobacter which grows and fixes nitrogen in very acid media. This organism was isolated from acid soils (pH 4.9 to 5.2) of India by P. K. De and has been cultivated in laboratory media for several years.[5] It develops well in nitrogen-free liquid media and upon agar slants from the acid limit which appears to be close to pH 3.0 up to at least pH 9.0. The organism develops well in nitrogen-free media similar to those commonly used for the well-known species of Azotobacter. Sucrose and glucose are readily utilized. During incubation for several weeks in a medium with an initial pH 3.1 and containing 1.5 gm of glucose, 9 mgm of nitrogen were fixed. Where the initial pH was 3.0, 3 mgm of nitrogen were fixed. Nitrogen fixation was greater between pH 3.8 and 8.0.

The acidity of the medium increases somewhat during development of the organism; the change in pH is greater in the alkaline and neutral media than in media which are close to the limiting acid reaction. During growth in media containing nitrate nitrogen the pH rises slightly, whereas in the presence of ammoniacal nitrogen the pH dropped from pH 6.5 to 3.5; this can be ascribed to the assimilation of the ammonium and nitrate nitrogen.

The unusual tolerance of the new organism to extreme acidity clearly distinguishes it from any of the previously described species of Azotobacter and indeed from practically all known bacteria. It appears to be at least as acid-tolerant as the anaerobic, nitrogen-fixing bacteria.[6] In fact, there are only exceptional species of bacteria which are able to develop at more acid reactions. Whether or not the acid-tolerant Azotobacter is widely distributed in soils or will develop in soils over as wide a range of reaction as in artificial media remains to be ascertained.

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HIPPOBOSCID FLIES FROM NORTH AMERICAN DOVES

G. R. COATNEY'S note in SCIENCE for September 16, 1938, on the possible carrier of dove Haemoproteus, may be supplemented with the following information.

Microlynchia pusilla (Speiser) is probably the most widely spread hippoboscid fly of doves. It is a strictly

[1] S. A. Waksman, "Principles of Soil Microbiology," 2nd ed. Williams and Wilkins Company, Baltimore, 1932. P. L. Gainey, Proc. and Papers of First Int. Congr. of Soil Sci., Washington, D. C. 3: 107–117, 1928.

[2] D. Burk, H. Lineweaver and C. K. Horner, *Jour. Bact.*, 27: 325–340, 1934.

[3] J. K. Wilson and B. D. Wilson, N. Y. (Cornell) Agr. Exp. Station, Memoir 148, 1933.

[4] D. Burk, Ergebnisse der Enzymforschung, v. 3: 23–56, 1934. D. Burk and H. Lineweaver, *Jour. Phys. Chem.*, 38: 35–46, 1934. D. Burk, C. K. Horner, and H. Lineweaver, *Jour. Cell. and Comp. Phys.*, 1: 435–449, 1932.

[5] A description of this organism will soon appear in *Soil Science*. In this report the organism is described as a new species of Azotobacter.

[6] W. H. Willis, Iowa Agr. Exper. Sta., *Res. Bul.*, 173, 1934.

[5] Giese, *Biol. Bull.*, 75: 238, 1938.

New World species, which I have seen from Bexar County, Texas, off mourning dove, *Zenaidura macroura carolinensis* (J. M. Brennan Collection); Carey, Blaine County, Idaho, off western mourning dove, *Zenaidura macroura marginella* (R. Matheson Collection); and from Pasadena, California, off the introduced and naturalized Chinese spotted dove, *Spilopelia chinensis* (Miss Josephine R. Michener Collection). Professor M. H. Swenk informs me that there is a specimen in the Department of Entomology of the University of Nebraska, taken in Nebraska, from the western mourning dove, April 20, 1920, by C. E. Mickel and R. W. Dawson. Ferris[1] recorded it from squabs of domestic pigeon at Thatcher, Arizona. I have seen many specimens from road-runner and Arizona quail, and a few from meadowlark, canyon towhee, Abert's towhee and western mockingbird. The species is known in the United States from Texas, Nebraska, Arizona, Idaho and California; and a specimen was taken in a market at Washington, D. C., off Arizona quail, evidently an accidental importation. Farther south it is recorded from Cuba, St. Croix, Grenada, Venezuela, Brazil, Paraguay and the Galapagos.

Stilbometopa podopostyla Speiser, also a strictly New World fly, is now known from Nebraska, Arizona, Texas (Bexar County, off *Zenaidura macroura carolinensis*.—J. M. Brennan Collection), Guatemala, the Republic of Honduras (Lancetilla near Tela, without host), Costa Rica (La Fuente, without host), British Guiana, Brazil and Paraguay (San Bernardino, without host). This fly is rare and host records are as yet few; but of the six species of birds from which it has been taken five belong to the dove family.

Ornithoctona erythrocephala (Leach), another fly restricted to the New World, is much more common than the Stilbometopa. It has a fairly large and varied host list. In the West Indies and tropical America it is reported from at least six species of wild doves and from domestic pigeon, as well as from a variety of other birds. Although by no means rare in North America, it has been taken there mostly from birds of prey, never from doves or pigeon. I have seen specimens from British Columbia, Alberta, the Province of Quebec, Maine, Massachusetts, Pennsylvania, North Carolina, Florida and Minnesota.

Ornithoica confluenta (Say), also strictly American, is one of the most common and most widely spread hippoboscids in this country. Its host list is very extensive, but it is most frequent on small migratory birds. Birds of prey and wading birds are probably stray hosts only. No doubt Herman's single record from eastern mourning dove at North Eastham, Mass., is likewise based on an accidental occurrence.

The pigeon fly, *Pseudolynchia canariensis* (Macquart) (Syn.: *maura* Bigot; *lividicolor* Bigot) is at present cosmopolitan. In North America it is known from Washington, D. C., South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Arkansas and California. In the New World it is often common on domestic pigeon, but has never been found on a wild host. On the other hand, it has been taken from at least eight species of wild doves in Europe, Africa and the Philippines. Evidently this was originally an Old World fly, introduced by man into the Americas.

From the foregoing it would seem that *Microlynchia pusilla* is the most likely natural vector of dove Haemoproteus in North America. This fly, moreover, transmits *Haemoproteus columbae* from pigeon to pigeon, according to H. de Beaurepaire-Aragão.[2] Both *Stilbometopa podopostyla* and *Ornithoctona erythrocephala*, although perhaps potential carriers, are probably too rare in this country on wild doves to be of much importance. *Ornithoica confluenta* is not likely to act as the vector in nature. While *Pseudolynchia canariensis* has been shown to transmit the dove Haemoproteus from dove to pigeon in the laboratory, it probably never carries it from dove to dove in nature in North America.

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STOMATAL INDEX AND TRANSPIRATION RATE OF LEAVES

BOTANISTS studying number of stomata in unit surface areas of leaves have noticed great variation between leaves from the lower to the higher levels of plants. Because of this variation it has been impossible to determine, for purposes of comparing plants in breeding work dealing with stomatal number and transpiration rate, whether a leaf at any particular level is typical. Also, it has been impossible to anticipate rate of transpiration on the basis of stomatal number.

In studying different levels of Kentucky wonder bean plants I have observed that the leaves differ significantly in stomatal number for unit surface area from the lower to the higher levels but do not differ in transpiration rate or in stomatal index. Young plants of the Kentucky wonder variety were found to be uniform for the upper epidermis transpiration rate and for stomatal index; they were not uniform for stomatal number except for the upper surface of the juvenile leaves.

In studying juvenile leaves of the Kentucky wonder, black wax and pinto varieties and four segregates of a cross between the black wax and pinto varieties I have noticed that stomatal number of juvenile leaf is

[1] Ferris, *Canad. Entom.*, 62: 66, 1930.

[2] H. de Beaurepaire-Aragão, *Brazil-Medico*, 30: 353, 1916.

not always an indication of relative transpiration rate. In comparing plants of *Phaseolus vulgaris* transpiration rate parallels stomatal index but does not always parallel stomatal number.

These observations support the view that juvenile leaves may be used to advantage for comparing plants in breeding work dealing with transpiration rate. They also support the view that transpiration rate is associated with stomatal index and not with stomatal number. Stomatal index may be determined from any of the leaves of a young bean plant.

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SOCIETIES AND MEETINGS

THE NEW YORK MEETING OF THE AMERICAN PHYSICAL SOCIETY

THE two hundred and twenty-sixth regular meeting of the American Physical Society was held in New York City on Thursday, Friday and Saturday, February 23, 24 and 25, 1939. All regular sessions of the society devoted to the reading of contributed papers were held in the Pupin Physics Laboratories of Columbia University, while the Saturday morning symposium meeting devoted to television took place in Studio 3A of the National Broadcasting Company in the RCA building at 30 Rockefeller Plaza.

On Thursday morning the Inter-Society Color Council held its business session at 480 Lexington Avenue, and the afternoon was devoted to a technical session on color tolerances, sponsored jointly by the Inter-Society Color Council and the American Psychological Association. Seven papers were presented, dealing with such subjects as the physics of color tolerance, the psychophysics of color tolerance, the representation of color tolerances on the chromaticity diagram, specification of tolerances at the National Bureau of Standards, industrial color tolerances, the ratio method in the review of Munsell colors and color tolerances as affected by changes in composition and intensity of illumination and reflectance of background. At 8:00 o'clock on Thursday evening the council held a popular session on "Parade of Color," including discussions of color in medicine, paper, textiles, industry, lighting, psychology and fashion.

The sessions of the American Physical Society were opened at ten o'clock on Friday morning with a meeting of the council and the presentation of contributed papers. A wide range of subjects was covered, falling into a number of fields. These included reports of studies of field currents at high and low pressures, of field measurements and possible correction of aberrations for magnetic electron lenses, of magnetic susceptibilities in weak fields, studies on the magnetic anisotropy of iron-nickel and copper-nickel alloys, on the theory of paramagnetic relaxation and a new approach to the problem of ferromagnetism. Studies of the structure and properties of metals included papers on the optical and magneto-optical activity of nickel sulfate, α-hexahydrate, in the short infra-red spectrum, on the preparation of single crystals of iron, cobalt, nickel and their alloys, and on the magnetic anisotropy of iron-copper and copper-nickel alloys. In the field of atomic physics there were discussions on the theoretical constitution of metallic barium, on nuclear isomers in radioactive strontium and on the band structure of metallic copper. Discussions of centrifugation and related subjects included papers on a new adaptation of the Beams ultracentrifuge for liquids, on the separation of bromine isotopes by centrifugation and on the formation and properties of unsupported flowing liquid films. Papers were also presented dealing with some physical properties of liquid and solid HD, the lack of "sucking" action by the cathode blast of mercury vapor in a pool rectifier, and the striated luminous glow of the piezoelectric quartz resonator at flexual vibration frequencies. Finally, a paper was presented by Cartwright and Turner on their interesting method of reducing the reflection from glass by deposited multilayer films.

Four contributed papers were read before the Optical Society in its session on Friday morning, which was opened at 9:30 in the Physics Laboratories. They dealt with spectro-radiography with the cathode ray tube, the first spectrum of tin, the behavior of an interferometer in a gravitational field and a calculation of the luminous efficiency of ionized cesium vapor.

A program of eighteen contributed technical papers occupied the Friday afternoon session of the American Physical Society, which was opened at the Physics Laboratory at 2:00 P.M. The program was rendered of unusual interest by discussions by Niels Bohr and Enrico Fermi of the experiments in the disintegration of uranium recently undertaken with the Columbia cyclotron. A number of other fields were treated, including those of cosmic ray studies, with papers on comparisons of counter and electroscope measurements in the stratosphere, on the origin of the rays which produce the bursts of cosmic ray ionization, and on the design and construction of reliable Geiger-Muller counters, of x-rays especially in relation to therapeutics, with papers on a compact pressure-insulated electrostatic x-ray generator for cancer therapy, on some new features in the million-volt x-ray installation at the Memorial Hospital, and de-

scriptions of a portable gamma-ray detector and a measurement of gamma-radiation in roentgens, and of spectroscopy, with papers relating to the effect of pressure on the intensity of the recombination spectrum of mercury, the spectral distribution of energy in the recombination spectrum of mercury and the spectra of SnH and PbH at high pressure. Other discussions of structure included considerations of the binding energy of He^6 and nuclear forces, the theoretical binding energy of He^5, and the energy levels of H^3, He^3 and He^5. Papers were given concerning studies of radioactive Be^7, the self-energy of the electron, and competition between $p-n$ and $p-\gamma$ reaction, and papers were presented on such widely divergent subjects as a study of the Rossi transition curve for small angle showers in layers of iron and an electrophoretic demonstration of patent pores of human skin.

The five papers presented before the afternoon sessions of the Optical Society, which was also held in the Physics Laboratories, dealt with the physiological and psychological aspects of color perception and vision. They included studies of the comparative effect of cobra venom and opiates on acuity and field of vision, facts and theories of color blindness, an experimental determination of the spectral components of psychologically unique red, of hue, saturation and lightness of surface colors with chromatic illumination, and the effect of certain variables on hue, lightness and saturation of samples having identical trilinear coordinates.

On Friday evening a joint dinner of the societies was held at the Columbia University Men's Faculty Club.

On Saturday morning a joint session of the societies, in the form of a symposium and demonstration on television, was held in Studio 3A of the National Broadcasting Company in the R.C.A. building at 30 Rockefeller Plaza, opening at ten o'clock. Both the symposium and demonstration were striking and of great interest. The planned program had included papers by V. K. Zworykin, of the RCA Manufacturing Company, on electron optics as applied in television systems and by P. T. Farnsworth, of Farnsworth Television Incorporated, on the application of electron multipliers to television systems. It was found that Dr. Farnsworth was unable to be present, however, so Dr. Zworykin provided both papers, his first dealing with the historical development of the theory of television, his second devoted to a discussion of the present New York City installation recently completed by R.C.A. The demonstrations which followed were conducted by A. F. Van Dyke, of the Radio Corporation of America, and were of great interest, especially since installations both of the very large experimental projection receiver and of the type of receiver which will shortly be marketed for home use had been included in the studio and were operated simultaneously. The symposium was well attended.

The American Physical Society met in three sections on Saturday afternoon to hear a total of twenty-eight contributed papers. The papers presented before the first section dealt predominantly with scattering and other phenomena in the bombardment of matter by protons and neutrons, including studies of the resonance scattering of protons by lithium, the scattering of neutrons by hydrogen and deuterium molecules, the scattering of $D-D$ neutrons, the elastic scattering of fast neutrons, and the ionization produced in gases by fast neutron irradiation. There were also discussions on the nuclear moments of the rubidium and chlorine isotopes, the electric quadrupole moment of In^{115}, the temperature in white dwarf stars, the self-energy of the electron and general relativity theory and flat space.

The papers of the second group were somewhat miscellaneous and of very wide scope. There were discussions of thermal and stress dependence of elasticity in solids, determination of the nature of a light source from wide-angle interference measurements, the measurement of x-ray production in the range 0.8 to 2.0 million volts, the uniqueness of an x-ray crystal analysis, on a general equation of state with reference to the equations for ammonia and steam, on the probability of K ionization of nickel by cathode rays, the electronic structure of alloys, inertial mass and a discussion of the difference in scope of theoretical physics and pure mathematics.

Four papers in infra-red, ultra-violet and x-ray spectroscopy were presented before the third section on Saturday afternoon. These included studies of the infra-red spectra of the fatty acids, the infra-red absorption spectrum of phenol vapor, the absorption spectrum of heavy benzene at 2730–2205 Å and a description of an apparatus for determining the orientation of crystals by x-rays. There were also papers on a re-evaluation of the atomic constants, the accommodation coefficients of helium *vs.* nickel, an investigation of the gettering powers of various metals for the gases hydrogen, oxygen, nitrogen, CO_2 and air, on the thermal conduction of metallic contacts, and finally on a determination of the radon content of the spring waters of Fairmount Park, the last listed paper of the meetings.

The next meeting of the American Physical Society will be held in Washington, D. C., from April 27 to 29, with a subsequent meeting in June at Stanford University, California, the date of which is still to be determined.

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SPECIAL ARTICLES

PATHOGENIC PLEUROPNEUMONIA-LIKE MICROORGANISMS FROM ACUTE RHEUMATIC EXUDATES AND TISSUES

THE inoculation of chorioallantoic membranes of chicken eggs with exudates obtained from a number of patients with acute rheumatic fever has resulted in the development of characteristic lesions which have not appeared when similar membranes were inoculated with non-rheumatic exudates. These lesions have had the same general appearance in a number of different series where the inocula have been derived from arthritic exudates, pleural exudates or an excised erythema nodosum nodule. The characteristic lesions have usually not become definite until the third to fifth serial passage; but once having appeared they have been easily induced in as many as twenty-four passages at two- to four-day intervals. The use of a 10 per cent. human serum-saline mixture as a medium in which the ground membranes are suspended has proven an important part of the technique. Macroscopically the characteristic lesions consist of granules or pearl-like bodies, often best seen when viewed from the entodermal surface. Microscopically these areas eventually appear like globular structures surrounded with flattened epithelium, but containing in their center condensed eosinophilic material, apparently derived from the mesoderm, and varying amounts of mesodermal inflammatory reaction. The bodies appear to originate in the ectoderm; as they enlarge, they press downward into the mesoderm, and often push the entoderm ahead of themselves, so that they are most easily seen from the under surface of the membrane.

Occasionally membranes have become contaminated with ordinary bacteria. Under these circumstances they have presented quite a different appearance from that described above. When bacterial contamination has occurred, the ground membrane suspension has been subjected to Berkefeld N or V filtration, which has allowed the infectious agent to pass through.

Etherized mice inoculated intranasally with rheumatic arthritic or pleural exudates and with suspensions of chorioallantoic membranes, showing the characteristic lesions described above, have sickened and developed pneumonia in which the inciting agent has been transmissible from series to series by using as inocula, ground pneumonic lungs suspended in broth. Filtrates of these suspensions, passed through Berkefeld V candles, have induced the same type of pneumonia; and from these lungs ordinary bacteria have been absent, both from films and cultures. The equivocal nature of the evidence obtained from mouse pneumonia was recognized, because of the findings of Dochez[1] and Gordon,[2] respectively, and their collaborators, and of similar results in the Laboratories of the International Health Division.[3] In all those experiments, however, the induced pneumonia did not appear until after two or more mouse lung passages, while in our experience the characteristic pneumonia appeared after the primary intranasal inoculation. Suspensions of these pneumonic lungs which had been ground have induced the same characteristic lesions on the chorioallantoic membranes as those previously mentioned.

As Dr. Albert Sabin has consulted with us frequently during his work in recovering pleuropneumonia-like microorganisms from normal mice[4] and inducing with these cultures chronic arthritis in mice,[5] we applied the cultural techniques he was using and also some of the methods employed by Kleineberger.[6] After a few sub-cultures in beef-serum-dextrose-broth or on solid media rich in serum, it was possible to grow pleuropneumonia-like microorganisms from the pneumonic mouse lungs and also from the abnormal chorioallantoic membranes. This was highly suggestive evidence that this agent had arisen from a common source—*viz.*, the exudates or lesions of patients with rheumatic fever—although the possibility was recognized that these pleuropneumonia-like microorganisms might have come from carriers among the sick mice, even though that possibility seemed improbable.

It, therefore, became important to cultivate, if possible, these microorganisms directly from rheumatic exudates; and by using the same culture media and applying the same repeated passage techniques that were used in culturing the chorioallantoic membranes and pneumonic mouse lungs, similar appearing cultures and microorganisms have been obtained from the arthritic exudate of a child early in the course of her second attack of rheumatic fever, and also from an erythema nodosum nodule excised from a patient with typical rheumatic polyarthritis. This furnished evidence that the pleuropneumonia-like microorganisms obtained from both the chorioallantoic membranes and from the mouse pneumonic lungs were probably derived originally from the rheumatic exudates.

The pathogenicity of the cultures from the three different sources is being investigated. A culture, free from ordinary bacteria, was obtained from the nineteenth chorioallantoic membrane passage where the original inoculum was a rheumatic pleural exudate. One tenth of a cubic centimeter of this culture, after four days' incubation, was injected into the vitreous

[1] A. R. Dochez, K. C. Mills and B. Mulliken, *Proc. Soc. Exp. Biol. and Med.*, 36: 683, 1937.

[2] F. B. Gordon, G. Freeman and J. M. Clampit, *Proc. Soc. Exp. Biol. and Med.*, 39: 450–453, 1938.

[3] F. L. Horsfall, personal communication.

[4] A. B. Sabin, SCIENCE, 88: 575–576, 1938.

[5] A. B. Sabin, SCIENCE, 89: 228–229, 1939.

[6] E. Kleineberger, *Jour. Hygiene*, 38: 458–475, 1938.

of the eyes of three rabbits. Two of them developed marked iritis and also a systemic reaction indicated by diarrhea of several days' duration; the third had a panophthalmitis with some form of cocci as contaminating agents. Another set of three rabbits was inoculated with the seventh and eighth subcultures from an arthritic exudate (this culture had never undergone animal passage); one rabbit developed marked iritis and diarrhea, the second mild iritis; while the eye of the third has so far remained free from macroscopic lesions. Two out of three other rabbits inoculated with a 24-hour-old culture of the same strain developed definite iritis after 9 or 10 days; while the iritis in the first two groups appeared between the second and fifth days after inoculation and persisted from the seventh to tenth.

Four series of Swiss mice, of a stock known to be free from mouse typhoid infection, were inoculated intranasally with the same cultures that had been injected into rabbits' eyes. During the following six days, animals in each set were obviously sick and had dyspnea. When autopsied on the sixth or seventh days, 3 out of 5 mice inoculated with the 4-day-old culture showed only macroscopically equivocal pulmonary lesions. On the other hand, marked pneumonia was present in 2 out of 5 mice in each of the three sets inoculated with either 1- or 2-day-old cultures. Another macroscopically normal appearing mouse lung was found upon microscopic examination to have foci of interstitial pneumonia, perivascular hyperplasia and bronchi distended with polymorphonuclear cells, a picture that has been peculiar to all the pneumonic lungs examined.

It thus appears that pleuropneumonia-like microorganisms cultured directly from rheumatic exudates can induce the same type of pneumonia in mice that is obtained by inoculating these animals with rheumatic exudates, or with suspensions of chorioallantoic membranes in which characteristic lesions have been induced by these exudates. These pulmonic lesions have appeared in the first mice inoculated with these various materials, as well as in those where serial transfers have been carried out; hence we feel that the organotropism of these microorganisms is different from those of the pleuropneumonia-like microorganisms recovered from mice by Dr. Sabin, for he has been unable to induce pneumonia in mice with his cultures.[7] A few mice inoculated either intracerebrally, intravenously or intraperitoneally with cultures have, so far, shown no characteristic lesions, even though some of them have been obviously sick. The series has been too small, however, and the time since inoculation too short for final judgment concerning the pathogenicity of these cultures.

SUMMARY

In suitable cell-free media it has been possible to cultivate pleuropneumonia-like microorganisms from the following materials, first, from chorioallantoic membranes in which lesions were apparently induced by exudates from patients with rheumatic fever; second, from pneumonic lungs of mice inoculated with similar exudates or with suspensions of the above-mentioned abnormal membranes; and third, directly from the arthritic exudate of a patient with rheumatic fever, and also from an erythema nodosum nodule excised from a patient with this same disease. With three different subcultures from joint fluid, iritis has been induced in rabbits; and following intranasal inoculation with the same cultures there has developed in mice a pneumonia similar to that found in mice inoculated with rheumatic exudates and with suspensions of chorioallantoic membranes infected with rheumatic exudates. Therefore it seems probable that in all instances the pathogenic agent was derived from similar sources, *viz.*, patients with rheumatic fever. Further work will be required to demonstrate the etiologic significance of these pathogenic agents in rheumatic fever.

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[7] A. B. Sabin, personal communication.

THE PROCESS OF CONTINUOUS DEAMINATION AND REAMINATION OF AMINO ACIDS IN THE PROTEINS OF NORMAL ANIMALS

WE have shown[1] that the feeding of *dl*-tyrosine with an increased concentration of the nitrogen isotope N^{15} to normal rats kept in nitrogen equilibrium leads not only to the incorporation of isotopic tyrosine into the tissue proteins, but also to the formation of other isotopic amino acids. This transfer of the nitrogen from one protein constituent to others could only have been due to chemical reactions, one of which must have involved the opening of peptide linkages. It was suspected that the mechanism responsible was that of deamination of tyrosine (to the corresponding α-keto acid?) coupled with the amination of another substance (α-keto acid?) to form the new amino acid. A process of this type was first proposed by Braunstein and Kritzman[2] and demonstrated in minced muscle. In our experiments the transfer of N^{15} from tyrosine into the α-amino group, but not into the ring,[3] of histidine offered strong evidence for the hypothesis that the shift of nitrogen from one amino acid to another is a normal event, which occurs at a rapid rate.

However, the possibility was not excluded that the

[1] R. Schoenheimer, S. Ratner and D. Rittenberg, *Jour. Biol. Chem.*, 127: 333, 1939.

[2] A. F. Braunstein and M. G. Kritzman, *Enzymologia*, 2: 129, 1937.

[3] R. Schoenheimer, D. Rittenberg and A. S. Keston, *Jour. Biol. Chem.*, 127: 385, 1939.

transfer of the nitrogen of one amino acid into other amino acids is also associated with a more fundamental synthesis of the carbon chain of the latter. We are now able to offer proof of the occurrence of extensive deamination and reamination of amino acids of the proteins in normal animals, by following the fate of the amino acid *l*-leucine, which contained two different and independent isotopes, namely, deuterium in the carbon chain and N^{15} in the amino group.

Four adult rats were kept on an ordinary stock diet (containing 15 per cent. casein) in nitrogen equilibrium without change of weight. To the diet was added an amount of *l-leucine* corresponding to 23 mg of nitrogen per rat per day for three days; the animals were then immediately killed by exsanguination. The leucine (possessing the natural configuration) contained 3.6 atom per cent. deuterium and 6.5 atom per cent. N^{15}; it was obtained by resolution of the synthetic racemic mixture described before.[4] While the total amount of nitrogen excreted corresponded to that in the diet, the excreta contained only 30 per cent. of the administered isotopic nitrogen, most of the remainder being incorporated in the body proteins. Only 8 per cent. was found in the "non-protein nitrogen" of the tissues.

The proteins of the liver, of the intestinal wall and of the remaining carcass were worked up separately, and the following analytically pure amino acids were isolated from the different proteins: three preparations each of arginine, tyrosine, glutamic acid, aspartic acid and leucine; two preparations of glycine and lysine, and one preparation of ornithine obtained by degradation of liver arginine. All the compounds, with the exception of the two lysine preparations, contained appreciable amounts of nitrogen isotope, a finding which corroborates our earlier observations after feeding tyrosine. The isotope concentration in the three leucine preparations was considerably higher than that of any other amino acid obtained from the same protein.

Indication of the mechanism responsible for the nitrogen transfer was obtained by the closer investigation of the leucine isolated from the proteins of the animals. The isotope (D and N^{15}) concentrations of the leucine isolated were considerably lower than those of the material fed. This was to be expected, as the dietary leucine was mixed with the ordinary leucine of the casein and with that of the tissue proteins into which the dietary leucine was introduced. If the leucine isolated from the tissues were only "diluted" by this "ordinary leucine," the ratio of the concentrations of the two isotopes in the compound should have been the same as in the material fed. The ratio ($D:N^{15}$), however, was altered considerably. It was 100:167 in the leucine administered and 100:103 in that isolated from the carcass. This result indicates that the carbon chain of leucine (characterized by the labeled hydrogen) had given up part of its nitrogen (in the present case labeled nitrogen) and in turn had "accepted" new nitrogen (which was normal). The other amino acids were obviously also involved in this process, in that they gave up normal nitrogen and accepted isotopic nitrogen from leucine.

The rapid introduction of a dietary amino acid into the tissue proteins, as well as the rapid and continuous deamination and amination of a large number of amino acids demonstrated in proteins of different organs has here taken place in normal adult animals on a stock diet. As all these reactions require the opening of peptide linkages in the protein, the finding is a new indication of the high chemical activity of the tissue proteins. The experimental details and their physiological and chemical implications will be presented elsewhere.

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[4] R. Schoenheimer and S. Ratner, *Jour. Biol. Chem.*, 127: 301, 1939.

A METHOD FOR PRODUCING PERSISTENT HYPERTENSION BY CELLOPHANE

IT has been found that arterial hypertension can be produced in dogs by wrapping one or both kidneys in Cellophane.

Dogs were anesthetized, a kidney freed from its bed, and after stripping off the fat on the surface, Cellophane sterilized in alcohol was gently wrapped around it and secured either with paper clips or a ligature. It is not necessary that very accurate approximation of the kidney and Cellophane occur. The kidney is gently replaced and the wound closed. This procedure may be repeated on the opposite kidney.

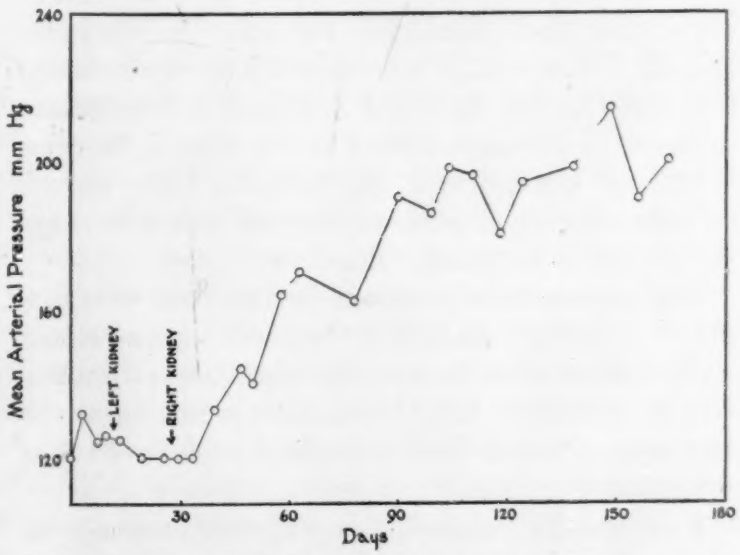

FIG. 1. Both kidneys were placed in Cellophane and blood pressure measured by intra-femoral puncture.

After about two to three weeks the arterial pressure, as measured by direct intra-arterial puncture of the femoral artery, begins to rise and may reach levels as high as 240 mm Hg mean pressure after a month or two. In some animals the pressure reaches a peak and tends to fall to lower levels, while in others the pressure has remained at high levels for seven months, *e.g.*, as long as the animals have been observed. Application of Cellophane to one kidney causes hypertension, but it is not so extreme as when both kidneys are treated.

At autopsy the kidney is found to be surrounded by a dense hull of tissue (fibroblastic and collagenous) as much as 4 to 5 mm thick. This is readily stripped from the surface of the kidney.

Hypertension produced by this method occurs whether the normal capsule is stripped or not before application of Cellophane. Denervation of the kidneys also does not interfere with its development. Removal of the offending kidney in animals in which hypertension has occurred after applying Cellophane to only one kidney causes the hypertension to disappear if it has not persisted for a long time.

We have not been able to produce hypertension by applying rubber (rubber surgical glove) to the kidneys. Other organs such as the heart, liver and adrenal glands have been enclosed in Cellophane, but it is too early to be certain of the results. In three experiments the pericardium showed signs of developing a constricting envelope, but the animals died before signs of constrictive pericarditis occurred.

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THE SUCCESSFUL TREATMENT OF MENINGO-ENCEPHALITIS, ASSOCIATED WITH CANINE DISTEMPER, WITH SULFANILAMIDE

MENINGO-ENCEPHALITIS associated with canine distemper has been considered for years an incurable disease. The mortality rate reported by veterinarians is from 90 to 100 per cent. Goldberg and Volgenau[1] reported on 73 cases treated at the New York State Veterinary College with one recovery. Our records indicate the rate to be essentially 100 per cent. when the disease is accurately diagnosed.

Canine distemper produced by the virus of Carré can be readily controlled by homologous serum, which has no effect on meningo-encephalitis. Sulfanilamide has little value as a therapeutic agent for distemper, in our own experience and in that of veterinarians generally.

The specific etiological agent for meningo-encephalitis associated with canine distemper is, however, unknown. Some believe that the virus of Carré is responsible, others that it is a bacterial invasion secondary to the virus of Carré and still others that it is due to certain specific bacteria and their toxins. In our work we have been unable to demonstrate any microorganisms in the brain or spinal fluid of dogs affected with meningo-encephalitis associated with canine distemper.

We have used sulfanilamide to treat fourteen dogs suffering from meningo-encephalitis associated with canine distemper. The sulfanilamide was administered in such dosage either by mouth or subcutaneously so that the sulfanilamide blood level was maintained at not less than 15 mgms per cent. Experience has shown that it is desirable to maintain this blood sulfanilamide level and that the administration of the drug should be started in the initial stages of the disease before extensive pathological changes are manifest.

Thirteen of the dogs have made complete recoveries. This is a recovery rate of about 93 per cent. compared to a mortality rate of from 90 to 100 per cent. in dogs not receiving sulfanilamide. There was a marked and rapid clinical improvement which usually took place in from 48 to 96 hours. Dogs with total anorexia started to eat. If the temperature was elevated it returned to normal. In the affected animals there was a lymphocytic leucopenia and a polymorphonuclear leucocytosis. After treatment with sulfanilamide, there was a favorable increase in the lymphocytes and a reduction in the polymorphonuclear leucocytes. The red cell count and the haemoglobin was not altered.

A detailed report of this work will appear later in another journal.

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